

IN THE CLAIMS

Claim 1 has been cancelled.

1. (Cancelled)

2-3. (Cancelled)

Claim 4 has been amended as follows:

4. (Currently Amended) A method for detecting cardiac rhythm abnormality, comprising the steps of:

providing a plurality of electrodes at a tip of a cardiac lead, which are electrically separated from each other;

placing said tip of said cardiac lead in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

obtaining individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

~~analyzing said time relationship by correlating one of said unipolar signals with another of said unipolar signals to obtain a correlation result, and generating said signal indicating a cardiac rhythm abnormality dependent on said correlation result~~

defining a time window;

sampling one of said unipolar signals and another of said unipolar signals;

correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result;

successively shifting said time window by one sample and, after each shift,
again correlating the samples of said one of said unipolar signals in
said time window with the samples of said another of said unipolar
signals in said time window, to obtain a plurality of successive
correlation results;
identifying a time offset between said one of said unipolar signals and said
another of said unipolar signals by a number of samples associated
with a shift of said time window which produced a highest correlation
result among said first and successive correlation results; and
generating a signal indicating a cardiac rhythm abnormality dependent on said
time offset.

Claim 5 has been cancelled.

5. (Cancelled)

6. (Cancelled)

Claim 7 has been cancelled.

7. (Cancelled)

8-9 (Cancelled)

Claim 10 has been cancelled.

10. (Cancelled)

Claim 11 has been amended as follows:

11. (Currently Amended) A method as claimed in claim 4 4 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

Claim 12 has been amended as follows:

12. (Currently Amended) A method as claimed in claim 4 4 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

Claim 13 has been amended as follows:

13. (Currently Amended) A method as claimed in claim 4 4 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

Claim 14 has been amended as follows:

14. (Currently Amended) A method as claimed in claim 4 4 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

Claim 15 has been amended as follows:

15. (Currently Amended) A method for detecting cardiac rhythm abnormality, comprising the steps of:

providing a plurality of electrodes at a tip of a cardiac lead, which are electrically separated from each other;

placing said tip of said cardiac lead in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

obtaining detections of individual unipolar electrical signals from said cardiac tissue respectively via said electrodes;

selecting a heartbeat representing a cardiac rhythm abnormality;

storing a detection pattern for the individual unipolar electrical signals obtained during said heartbeat as a template; and subsequently obtaining further detections of individual unipolar electrical signals from said cardiac tissue respectively via said electrodes and comparing said subsequently obtained detections of unipolar signals to said stored template to obtain a comparison result, and generating a signal indicating a cardiac rhythm abnormality dependent on said comparison result.

16. (Original) A method as claimed in claim 15 wherein the step of comparing said subsequently obtained detections of unipolar signals to said template comprises conducting a pattern recognition between said subsequently obtained detections of unipolar signals and said template.

17. (Original) A method as claimed in claim 15 wherein the step of selecting a heartbeat representing a cardiac rhythm abnormality comprises selecting a plurality of different heartbeats respectively representing different cardiac rhythm abnormalities, and wherein the step of storing a detection pattern comprises storing a plurality of respective detection patterns for the individual unipolar electrical signals respectively obtained during said different heartbeats, as a plurality of templates respectively for said different cardiac rhythm abnormalities, and wherein the step of comparing said subsequently obtained detections of unipolar signals to said stored template comprises comparing said subsequently obtained detections of unipolar signals to the plurality of stored templates to obtain a comparison result indicating which of said templates said subsequently obtained detections of unipolar signals most closely resembles, and generating a signal indicating the respective cardiac

rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

18. (Original) A method as claimed in claim 15 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

19. (Original) A method as claimed in claim 15 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

20. (Original) A method as claimed in claim 15 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

21. (Original) A method as claimed in claim 15 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

Claim 22 has been cancelled.

22. (Cancelled)

23-24 (Cancelled)

Claim 25 has been amended as follows:

25. (Currently Amended) A cardiac rhythm abnormality detector comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement in contact with cardiac tissue

so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

a QRS detector connected to said cardiac lead which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

~~an evaluation circuit which analyzes said time relationship by correlating one of said unipolar signals with another of said unipolar signals to obtain a correlation result, and generates said signal indicating a cardiac rhythm abnormality dependent on said correlation result~~

an evaluation circuit that correlates said one of said unipolar signals with another of said unipolar signals by defining a time window, sampling said one of said unipolar signals and said another of said unipolar signals, correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result, successively shifting said time window by one sample and, after each shift, again correlating the samples of said one of said unipolar signals in said time window with the samples of said another of said unipolar signals in said time window, to obtain a plurality of successive correlation results, identifying a time offset between said one of said unipolar signals and said another of said unipolar signals by a number of samples associated with a shift of said time window which produced a highest correlation result among said first and successive correlation results,

and said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

Claims 26 and 27 have been cancelled.

26-27 (Cancelled).

Claim 28 has been amended as follows:

28. (Currently Amended) A cardiac rhythm abnormality detector as claimed in claim 22 25 wherein said plurality of electrodes are respective dot-like electrodes.

Claim 29 has been amended as follows:

29. (Currently Amended) A cardiac rhythm abnormality detector as claimed in claim 22 25 wherein said plurality of electrodes at said tip of said cardiac lead are disposed with respective spacings between the electrodes which are substantially equal.

Claim 30 has been amended as follows:

30. (Currently Amended)) A cardiac rhythm abnormality detector as claimed in claim 22 25 wherein one of said electrodes is disposed at a center of said tip of said cardiac lead, with a remainder of said electrodes disposed symmetrically relative to said one of said electrodes.

31. (Previously Presented) A cardiac rhythm abnormality detector as claimed in claim 30 wherein said remainder of said electrodes are disposed radially symmetrically relative to said one of said electrodes.

32. (Original) A cardiac rhythm abnormality detector, comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which is electrically separated from each other, said tip of said cardiac lead being adapted for placement contact with cardiac tissue so that all

of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

a QRS detector connected to said cardiac lead which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes;

an extracorporeal programming device which allows selection of a heartbeat representing a cardiac rhythm abnormality by taking detections from the individual unipolar signals into account;

a template memory in which the detection pattern obtained at said cardiac rhythm abnormally is stored as a template;

said QRS detector subsequently obtaining further individual unipolar electrical signals from said cardiac tissue respectively via said electrodes; and

an evaluation circuit which compares said subsequently obtained unipolar signals to said stored template to obtain a comparison result, and generates a signal indicating a cardiac rhythm abnormality dependent on said comparison result.

33. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 wherein said evaluation circuit compares said subsequently obtained unipolar signals to said template comprises conducting a pattern recognition between said subsequently obtained unipolar signals and said template.

34. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 wherein said extracorporeal programming device allows selection of a plurality of different heartbeats respectively representing different cardiac rhythm abnormalities by taking detections from the individual unipolar signals into account, and wherein

said template memory stores a plurality of detection patterns respectively obtained at said different cardiac rhythm abnormalities, and wherein said evaluation circuit compares said subsequently obtained unipolar signals to said plurality of stored templates to obtain a comparison result indicating which of said stored templates said subsequently obtained unipolar signals most closely resemble, and wherein said evaluation circuit generates a signal indicating a type of cardiac rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

35. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

36. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

37. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

38. (Original) A cardiac rhythm abnormality detector as claimed in claim 32 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

Claim 39 has been amended as follows:

39. (Currently Amended) An implantable cardiac assist device comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

an electrical stimulation generator connected to said cardiac lead for delivering electrical stimulation to said cardiac tissue via said plurality of electrodes;

a control unit connected to said electrical stimulation generator;

a QRS detector which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

~~an evaluation circuit which analyzes said time relationship to obtain an analysis result and generates a signal indicating a cardiac rhythm abnormality dependent on said analysis result to said control unit for triggering delivery of said electrical stimulation by said electrical stimulation generator.~~

an evaluation circuit that correlates said one of said unipolar signals with another of said unipolar signals by defining a time window, sampling said one of said unipolar signals and said another of said unipolar signals, correlating samples in said time window of said one of said unipolar signals with samples in said time window of said another of said unipolar signals to obtain a first correlation result, successively shifting said time window by one sample and, after each shift, again

correlating the samples of said one of said unipolar signals in said time window with the samples of said another of said unipolar signals in said time window, to obtain a plurality of successive correlation results, identifying a time offset between said one of said unipolar signals and said another of said unipolar signals by a number of samples associated with a shift of said time window which produced a highest correlation result among said first and successive correlation results, and said evaluation circuit generates said signal indicating a cardiac rhythm abnormality dependent on said time offset.

Cancel claims 40, 41, 42, 43 and 44.

40-44 (Cancelled).

45. (Original) An implantable cardiac assist device as claimed in claim 39 wherein said plurality of electrodes are respective dot-like electrodes.

46. (Original) An implantable cardiac assist device as claimed in claim 39 wherein said plurality of electrodes at said tip of said cardiac lead are disposed with respective spacings between the electrodes which are substantially equal.

47. (Original) An implantable cardiac assist device as claimed in claim 39 wherein one of said electrodes is disposed at a center of said tip of said cardiac lead, with a remainder of said electrodes disposed symmetrically relative to said one of said electrodes.

48. (Original) An implantable cardiac assist device as claimed in claim 39 wherein said remainder of said electrodes are disposed radially symmetrically relative to said one of said electrodes.

49. (Original) An implantable cardiac assist device comprising:

a cardiac lead having a plurality of electrodes at a tip of said cardiac lead, which are electrically separated from each other, said tip of said cardiac lead being adapted for placement in contact with cardiac tissue so that all of said electrodes are simultaneously in substantially fixed contact with said cardiac tissue;

an electrical stimulation generator connected to said cardiac lead for delivering electrical stimulation to said cardiac tissue via said plurality of electrodes;

a control unit connected to said electrical stimulation generator;

a QRS detector which obtains individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, said unipolar signals exhibiting a time relationship relative to each other; and

an extracorporeal programmer which allows selection of a heartbeat representing a cardiac rhythm abnormality by taking detections from the individual unipolar signals into account;

a template memory in which the detection pattern obtained at said cardiac rhythm abnormality is stored as a template;

said QRS detector subsequently obtaining further individual unipolar electrical signals from said cardiac tissue respectively via said electrodes; and

an evaluation circuit which compares said subsequently obtained unipolar signals to said stored template to obtain a comparison result, and which generates a signal indicating a cardiac rhythm abnormality dependent on said comparison result to said control unit for triggering

delivery of said electrical stimulation by said electrical stimulation generator.

50. (Original) An implantable cardiac assist device as claimed in claim 49 wherein said evaluation circuit compares said subsequently obtained unipolar signals to said template comprises conducting a pattern recognition between at least one of said subsequently obtained unipolar signals and said template.

51. (Original) An implantable cardiac assist device as claimed in claim 49 wherein said extracorporeal programming device allows selection of a plurality of different heartbeats respectively representing different cardiac rhythm abnormalities by taking detections from the individual unipolar signals into account, and wherein said template memory stores a plurality of detection patterns respectively obtained at said different cardiac rhythm abnormalities, and wherein said evaluation circuit compares said subsequently obtained unipolar signals to said plurality of stored templates to obtain a comparison result indicating which of said stored templates said subsequently obtained unipolar signals most closely resemble, and wherein said evaluation circuit generates a signal indicating a type of cardiac rhythm abnormality, from among said plurality of cardiac rhythm abnormalities, dependent on said comparison result.

52. (Original) An implantable cardiac assist device as claimed in claim 49 comprising forming individual electrodes in said plurality of electrodes as respective dot-like electrodes.

53. (Original) An implantable cardiac assist device as claimed in claim 49 comprising arranging said plurality of electrodes at said one end of said cardiac lead with respective spacings between the electrodes which are substantially equal.

54. (Original) An implantable cardiac assist device as claimed in claim 49 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes symmetrically relative to said one of said electrodes.

55. (Original) An implantable cardiac assist device as claimed in claim 49 comprising disposing one of said electrodes at a center of said one end of said cardiac lead, and arranging a remainder of said electrodes radially symmetrically relative to said one of said electrodes.

Claim 56 has been amended as follows:

56. (Currently Amended) A method as claimed in claim ~~4~~ 4 wherein the step of obtaining individual unipolar electrical signals comprises obtaining a plurality of individual unipolar electrical signals from said cardiac tissue respectively via said electrodes with one unipolar signal being obtained for each electrode, making the plurality of unipolar signals equal to the plurality of electrodes.

Claim 57 has been amended as follows:

57. (Currently Amended) A cardiac rhythm abnormality detector as claimed in claim ~~22~~ 25 wherein said QRS detector is connected to said electrode lead for obtaining a plurality of said individual unipolar electrical signals from said cardiac tissue respectively via said electrodes, with one unipolar signal being obtained for each electrode, making the plurality of unipolar signals equal to the plurality of electrodes.